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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Inventors: Arlen L. Roesner, et al.

Serial No.: 10/017,543 /

Art Unit: 2835

Filed: December 13, 2001

Examiner: Chervinsky, Boris L.

Title: THERMAL INTERFACE

BRIEF ON APPEAL

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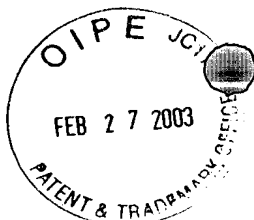
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Title: **THERMAL INTERFACE**

BRIEF ON APPEAL

1. Real Party in Interest

The real party in interest is Hewlett-Packard Company, Palo Alto, California, the owner and assignee of the subject application.

2. Related Appeals and Interferences

There are no known related appeals or interferences.

3. Status of Claims

This is an appeal from the Examiner's final rejection of claims 1-30. No claim has been allowed and no claim has been canceled.

4. Status of Amendments

No amendment has been filed in this application subsequent to the Final Office Action dated October 24, 2002.

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5. Summary of the Invention

a. The Problems Faced By The Prior Art

Many electronic components such as semiconductor packages, whether containing integrated circuits or individual devices such as diodes or power transistors, dissipate sufficient heat to require thermal management utilizing heat sinks.

Thermal interfaces have been developed for transferring the heat produced by a heat-dissipating electronic component to a heat sink. A thermal interface may simply comprise a thin film or layer of a thermally conductive filler material such as silicone grease. Because silicone grease remains semi-liquid at room temperature, the electronic component and the heat sink may be readily separated to facilitate field servicing, component upgrades, and so forth. However, silicone grease is not favored because it is a messy contaminant that is not easily removed from clothing or equipment.

Other filler materials in common use include thermal compounds comprising a paraffin base with additives for enhancing thermal conductivity. Such compounds are characterized by temperature responsive phase-changes so that the compound is dry, clean and therefore easy to handle at room temperature but liquefies at elevated temperatures so that the material flows into the irregularities in the confronting surfaces of the heat sink and the electronic component. The disadvantage of such phase-change compounds is that when they revert to the solid state upon cooling, they tend to bond to the surfaces to which they have been applied so that separation of the electronic component and the heat sink may be difficult.

Multilayer thermal interfaces adapted to be interposed between a heat-dissipating electronic component and a heat

sink are also known. One such known interface comprises a thin, thermally-conductive metal foil coated on both sides with a paraffin-base, change-of-state thermal compound. Another known multilayer thermal interface comprises four layers, including a pair of metal foils sandwiched between outer layers of a paraffin-base, change-of-state compound. Four-layer interfaces, however, tend to increase the thermal impedance of the joint.

Prior to the present invention, there remained a need for a thermal interface for efficiently transferring heat away from a heat-dissipating electronic component to a heat sink, wherein the thermal interface facilitates separation of the heat sink from the electronic component, yet is clean, easy to handle and has a minimum number of layers.

b. The Solution Provided By The Appealed Claims

In accordance with one specific, exemplary embodiment of the invention, there is provided a thermal interface comprising a carrier having opposed surfaces, a layer of a phase-change material on one of the surfaces of the carrier, and a layer of a pliable, thermal compound such as a silicone grease on the other of the surfaces of the carrier.

In accordance with another specific, exemplary embodiment of the present invention, there is provided a thermal interface product that comprises a thermal interface as described above and that additionally comprises a removable, protective covering overlying the pliable, thermal compound layer.

Pursuant to yet another specific, exemplary embodiment of the present invention, there is provided an assembly comprising a substrate, an electronic component mounted on the substrate, a heat sink, and a thermal interface as described above interposed between a surface of the

electronic component and a confronting surface of the heat sink for transferring heat generated by the electronic component to the heat sink.

6. Issues

The issues involved in this appeal are:

a. Whether claims 1-4, 6-9, 22-25 and 27-30 are anticipated under 35 USC § 102(a) by Green, et al., U.S. Patent 6,197,859 (hereinafter "Green");

b. Whether claims 5 and 26 are unpatentable under 35 USC § 103(a) for obviousness over Green;

c. Whether claims 10, 11 and 13-21 are unpatentable under 35 USC § 103(a) for obviousness over Green in view of Tzeng, et al., U.S. Patent 6,245,400 (hereinafter "Tzeng"); and

d. Whether claim 12 is unpatentable under 35 USC § 103(a) for obviousness over Green in view of Tzeng and further in view of Lee, et al., U.S. Patent 6,049,458 (hereinafter "Lee").

7. Grouping of Claims

Claims 1, 10 and 22 are independent.

Claims 1-9 and 22-30 stand or fall together.

Claims 10, 11 and 13-21 stand or fall together.

Dependent claim 12 stands with claim 10 from which it depends, but in view of the additional patentable distinctions set forth therein, would fall separately from claim 10.

8. Argument

a. Description of the Present Invention

FIG. 1 shows an assembly 10 comprising a heat-dissipating electronic component 12 mounted on a substrate 14, a heat sink 16 for dissipating heat generated by the electronic component, and a thermal interface 18 constructed in accordance with the present invention. The thermal interface is adapted to be interposed between and to thermally couple a surface 20 of the heat sink 16 with a surface 22 of the electronic component 12.

With reference to **FIG. 2**, there is shown a thermal interface product 30 including the combination of the thermal interface 18 and a removable protective covering in the form of a backing sheet or release liner 32.

The thermal interface 18 basically comprises a three-layer structure. A first layer 34 comprises a thermally-conductive phase-change compound applied to a first surface 36 of a second interface layer 38 comprising a thin, thermally-conductive metal or plastic carrier. The third layer 40 of the thermal interface 18 comprises a silicone-type grease or paste applied to a second surface 42 of the carrier 38. The grease layer 40 has an outer surface 44 covered by, and in contact with, the removable backing sheet or release liner 32.

In use, the protective release liner 32 is peeled away from the grease layer 40. The liner 32 can be discarded without the grease coming in contact with the user. The thermal interface 18 is then sandwiched between the confronting surfaces 20 and 22 of the heat sink 16 and the electronic component 12.

Should disassembly be required, separation of the components along the pliable, non-solid grease layer 40 is easily accomplished.

FIGS. 3-5 show a thermal interface product 50 in accordance with an alternative embodiment of the invention. The product 50 comprises a three layer thermal interface 52 comprising, as before, a carrier 54 having opposed surfaces one of which supports a layer 56 of thermally-conductive, silicone-type grease or paste, and the other of which receives a layer 58 of thermally-conductive phase-change material. Instead of a thin, flexible liner that contacts the grease layer as in the first embodiment (**FIG. 2**), overlying the grease layer 56 in the embodiment of **FIGS. 3-5** is a removable protective covering in the form of cap 62 that does not contact the grease layer.

When the thermal interface 52 is ready for installation, the cap 62, which covers and protects the grease layer 56 during shipment, is removed by simply pulling up on a lift tab 68.

The invention combines the advantages of each of the three thermal interface materials while eliminating or minimizing their respective disadvantages. The invention combines the cleanliness and thermal performance of a phase-change material, the thermal performance and non-adhesion of a thermal grease, and the ease of handling a foil or film carrier. Further, the thermal interface product minimizes the chances of a user contacting the grease, and particularly so during initial fabrication of the assembly. Moreover, the thermal interface of the invention has only three layers thereby optimizing heat transfer from the electronic component to the heat sink.

b. The Prior Art Disclosures

(1) The Green Patent

The Green patent describes in the "Background of the Invention" thereof, various phase-change thermal interface compounds that may be applied to one or both surfaces of a

suitable substrate. (Green, 1/15-61.) Green also discloses in the "Background" thereof the use of a single layer of thermally conductive silicone grease between an electronic package and a mounting surface. Green notes the disadvantage of silicone grease, namely, that the products on which it is used become messy. (Id., 2/27-49.) A principal object of the Green patent is to provide a thermally conductive coating that has consistent and uniform thickness and therefore predictability of performance, with the advantages to be obtained "without experiencing the problems inherent in applications of silicone grease". (Id., 2/51-61.)

The central contribution of the Green patent is a specific dry film, phase-change material formulation, the particulars of which are not relevant to the present matter.

The dry film, phase-change composition of the Green patent is applied on one side of a substrate (FIGS. 1A, 1B, 2 and 3) or on both sides of a substrate (FIG. 4). More specifically, in FIG. 4 a metal foil substrate 44 is coated on one side with a layer 45 of the dry film, phase-change composition of the Green invention and similarly on the other side with a layer 46 of the same dry film, phase-change composition.

(2) The Tzeng Patent

The Tzeng patent relates to a release-lined, pressure sensitive adhesive, flexible graphite thermal interface. The Tzeng interface comprises a flexible graphite substrate 11, an adhesive primer coating 12 on the substrate, a pressure sensitive adhesive coating 13 on the primer coating and a release liner 14 on the pressure sensitive adhesive coating. The release liner 14 is said to be easily

removed without any significant delamination of the flexible graphite substrate. (Tzeng, 2/3-9.)

(3) The Lee Patent

Lee discloses a heat sink 30 for dissipating heat generated by a CPU. The heat sink includes a base 31, heat dissipating fins 32 projecting from the base and a layer of thermal grease 40 spread on a middle portion of the heat sink base. A protective cap 50 is removably attached to the base to enclose the thermal grease so that the grease will not cause contamination during transportation or handling of the heat sink. (Lee, 2/31-35.)

c. The Examiner's Rejections

Claims 1-4, 6-9, 22-25 and 27-30 stand finally rejected as anticipated by Green under 35 USC § 102(a).

Claims 5 and 26 stand finally rejected under 35 USC § 103(a) as unpatentable for obviousness over Green.

Claims 10, 11 and 13-21 stand finally rejected under 35 USC § 103(a) as unpatentable for obviousness over Green in view of Tzeng.

Claim 12 stands finally rejected under 35 USC § 103(a) as unpatentable for obviousness over Green in view of Tzeng and further in view of Lee.

d. The Examiner's Rejections Are Erroneous

(1) The Examiner's Rejections of Claims 1-9 and 22-30 As Anticipated By Green Are Erroneous

Common to all of these claims is a thermal interface comprising:

a carrier having opposed surfaces;
a layer of phase-change material on one of the surfaces
of the carrier; and

a layer of a pliable, thermal compound on the other of the surfaces of the carrier.

The Green reference does not disclose the combination of elements constituting the claimed thermal interface. With reference to FIG. 4 of Green, the figure principally relied upon by the Examiner, the interface member 43 comprises a substrate 44 coated on both sides 45 and 46 with a dry film, phase-change material. Accordingly, the Examiner's statement on page 2 of the final Office Action that in Green "the carrier [has] a layer of a phase-change material on one side and a layer of a pliable thermal compound on the other side 45, 46" is clearly in error.

The further statement on page 2 of the final Action that "paraffin-based phase change materials and thermally conductive grease compounds are widely used and known" may be true, but again, nowhere in Green or in any other reference of which applicants are aware, is the claimed thermal interface combination to be found.

The Office Action also makes reference to the "Background of the Invention" section of Green. That section, in column 2 of the patent, describes the problems associated with silicone grease and explains that the Green invention overcomes those problems by using a dry film, phase-change material. In other words, the Green invention eliminates silicone grease which is one example of the "layer of a pliable, thermal compound" set forth in the claims of the present application. Once again, nowhere in the "Background of the Invention" of Green or anywhere else in that patent or in any other cited reference is the combination of elements of the thermal interface claimed in the present application disclosed or even suggested. Among other deficiencies, Green does not disclose or suggest a thermal interface comprising "a layer of phase-change material on one of the surfaces of the carrier" and "a

layer of a pliable, thermal compound on the other of the surfaces of the carrier".

It is respectfully submitted that the Examiner has read into Green a combination of elements that is not disclosed either expressly or inherently. Green mentions thermal grease and phase-change material, but nowhere in the reference is there any teaching of the combination that is claimed.

The Examiner has asserted on page 4 of the final Action that Green's "dry film phase change material is considered to be pliable and thermal material by definition". The Examiner has provided no support for this bald statement; for example, no reference has been cited for the mentioned "definition".

What is claimed in the present application is a thermal interface having three distinct layers. One of the layers is a "phase-change material"; in contrast, another of the layers is a "pliable, thermal compound". The Examiner's equating of these limitations "by definition" is simply an attempt to take an impermissible shortcut to reach the desired finding of anticipation.

The Examiner's response (final Action, page 4) to applicants' statement that the Green invention eliminates silicone grease is not understood. The passage from Green quoted by the Examiner simply states that "interface coatings of the present invention", that is, dry film, phase-change material coatings, may also be used along the surfaces of heat spreaders. The quoted passage makes no reference to silicone grease.

It is axiomatic that anticipation under 35 USC § 102 requires that "each and every element as set forth in [a] claim [be] found, either expressly or inherently described, in a single prior art reference". Verdegaal Bros., Inc. v. Union Oil Co., 814 F.2d 628, 2 USPQ2d 1051 (Fed. Cir.

1987). The Examiner has not shown the presence, either expressly or inherently, in Green of each and every limitation of claims 1 and 22. Accordingly, it is submitted that Green fails as an anticipatory reference.

With respect to the rejections of claims 2-9 and 23-30 that depend from claims 1 and 22, respectively, it is axiomatic that if an independent claim is patentable, the claims dependent therefrom are likewise patentable. In re Fine, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988). Therefore, it is submitted that like claims 1 and 22, dependent claims 2-9 and 23-30 are patentable.

(2) The Examiner's Rejections Of Claims 10, 11 and 13-21 As Unpatentable For Obviousness Over Green In View Of Tzeng Are Erroneous

Independent claim 10 relates to a thermal interface product comprising the thermal interface described in claim 1 further in combination with "a removable protective covering overlying the pliable, thermal compound layer".

First, all of appellant's earlier remarks regarding the patentability of independent claims 1 and 22 over Green are applicable to the rejections of claims 10, 11 and 13-21.

Second, in an effort to meet the limitations of claim 10, the Examiner, at page 3 of the final Action, has inadequately described the coating 13 in the Tzeng reference. The coating is not simply a "pressure sensitive layer" as described by the Examiner, but a "PSA coating", that is, a pressure sensitive adhesive coating. (For example, Tzeng, 6/23-24.) There is nothing in either of the references to suggest to one skilled in the art that the release liner 14 which overlies the pressure sensitive adhesive coating in the Tzeng reference should be used to cover a layer of pliable, thermal compound such as silicone

grease which is virtually the antithesis of an adhesive. Thus, the Examiner is incorrect in his assertion that "it would have been obvious at the time the invention was made to a person having ordinary skill in the art to use removable protective layer as disclosed by Tzeng in the structure disclosed by Green as to protect the pliable thermal compound layer prior to installation". (Final Action, page 3.) The Examiner has not pointed to any part of either of the references to support that statement and, indeed, cannot do so. The Examiner has simply seized upon the presence of a release liner in Tzeng and transferred that element -- divorced from its context -- to the Green reference. The attempted combination is clearly a hindsight reconstruction of the type prohibited by the Court of Appeals for the Federal Circuit. In re Bond, 910 F.2d 831, 15 USPQ2d 1566 (Fed. Cir. 1990).

The Examiner's statement on page 5 of the final Action that "the protective removable covering as disclosed by Tzeng et al. can be and, most likely, should be provided in Green disclosed structure, when pliable thermal compound is used on at least one side of the substrate" is pure speculation. In addition, as already pointed out, Green teaches away from the use of a "pliable, thermal compound". Accordingly, one skilled in the art having Green and Tseng before him, would avoid such compound and so would not be motivated to combine the Green and Tzeng references as urged by the Examiner. Last, the Examiner's statement as to what "can be and, most likely, should be provided" is, on its face, an erroneous test of obviousness and is inadequate to establish either a motivation for combining references or a reasonable expectation of success.

The rejection should be reversed because the necessary factors for combining references, including a suggestion of the combination in the prior art and the reasonable

expectation of success, are not present. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Both the suggestion and the reasonable expectation of success must be found in the prior art, and not in the applicant's disclosure. Id. And these requirements most certainly cannot be met based on idle speculation.

Accordingly, the rejections of independent claim 10 and claims 11 and 13-21 depending therefrom, should be reversed.

(3) The Examiner's Rejection Of Dependent Claim 12 As Unpatentable For Obviousness Over Green in View of Tzeng and Lee Is Erroneous

Claim 12 depends from claim 10. Accordingly, the comments made concerning the patentability of claim 10 over Green in view of Tzeng are equally applicable to claim 12.

Dependent claim 12 further defines the "removable protective covering" set forth in claim 10 as comprising "a cap removably attached to the carrier". The rejection of claim 12 adds to Green and Tzeng a third reference, the Lee patent. The inadequacy of the rejection of claim 12 is made manifest by the fact that the Examiner has made no attempt to show how the three references can be combined in any rational way. Indeed, Tzeng is not even mentioned. The Examiner's statement that "it would have been obvious...to have the protective removable cap as disclosed by Lee et al. in the device disclosed by Green et al. in order to protect pliable surface or thermal grease", has no support whatever in the applied art. Although Green mentions as prior art the use of thermal grease, no structure employing that material is shown or described in Green. In any event, as already emphasized, one of the main objects of Green is to eliminate thermal grease. Once again, it is submitted that the Examiner has simply extracted an element from the

prior art and used the claims in issue themselves as a road map in an attempt to come up with the claimed combination -
- again, a classical example of a hindsight reconstruction.

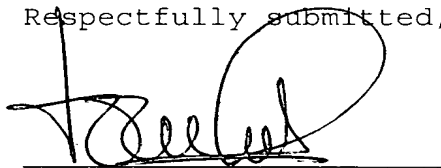
9. Conclusion

It is submitted that the Examiner has failed to carry the burden of establishing a *prima facie* case of unpatentability. The Examiner has not shown the presence of each and every claimed element in the prior art in support of the anticipation rejections.

It is further submitted that the Section 103(a) rejections fail to comply with the requirements for a rejection based on obviousness. Not only is at least one claimed limitation missing from the references, but there is no suggestion for combining the applied references as urged. There has not been cited, and it is submitted that the Office cannot cite, any suggestion in the art that the references relied upon, either by themselves or in combination, meet the limitations of the rejected dependent claims.

For the reasons stated, it is respectfully submitted that the Examiner's rejections are in error. The Examiner's rejections should be reversed and claims 1-30 should be allowed.

Respectfully submitted,



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